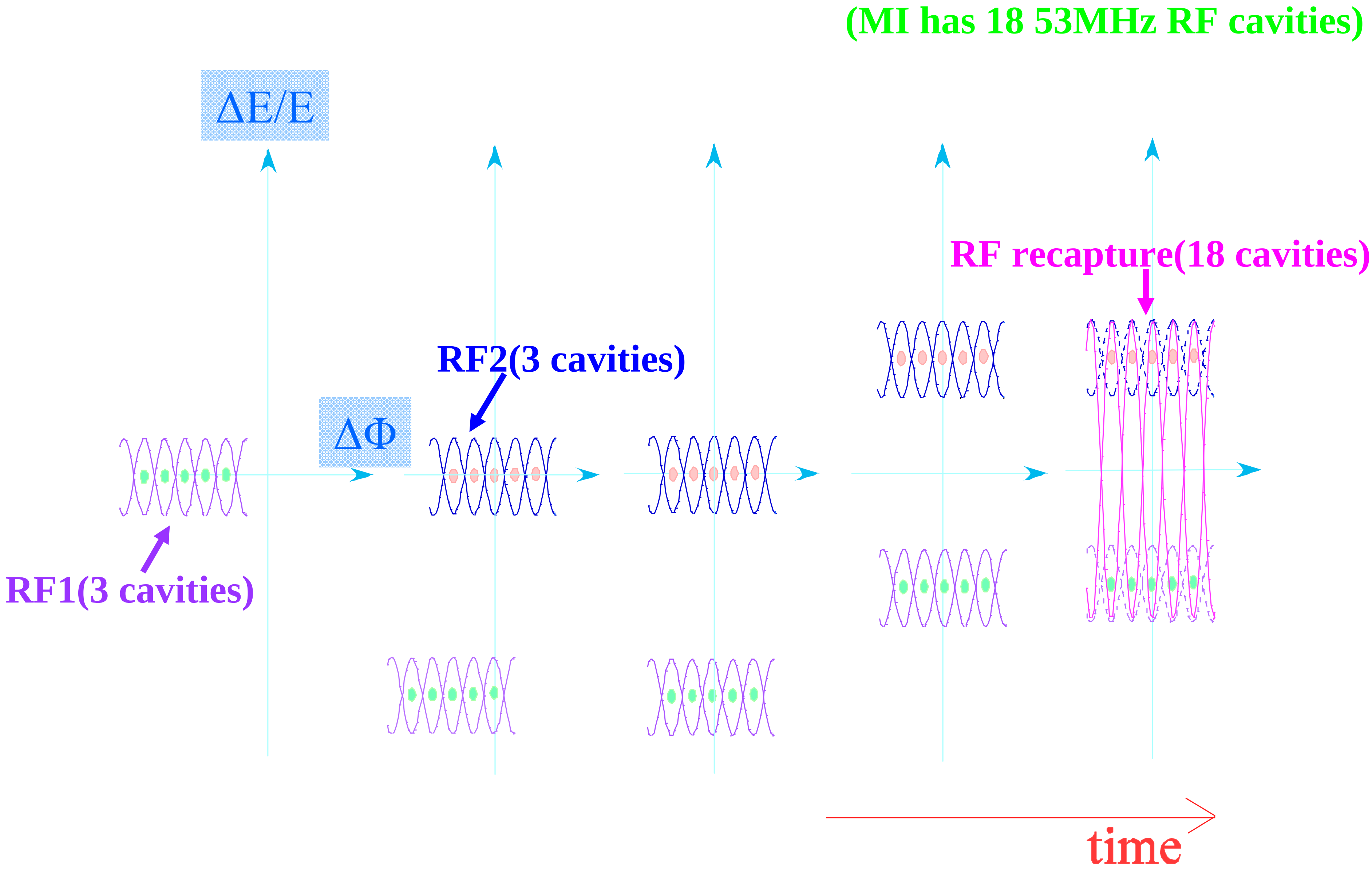
Slip Stacking Losses-Present and Future

I. Kourbanis, K. Seiya

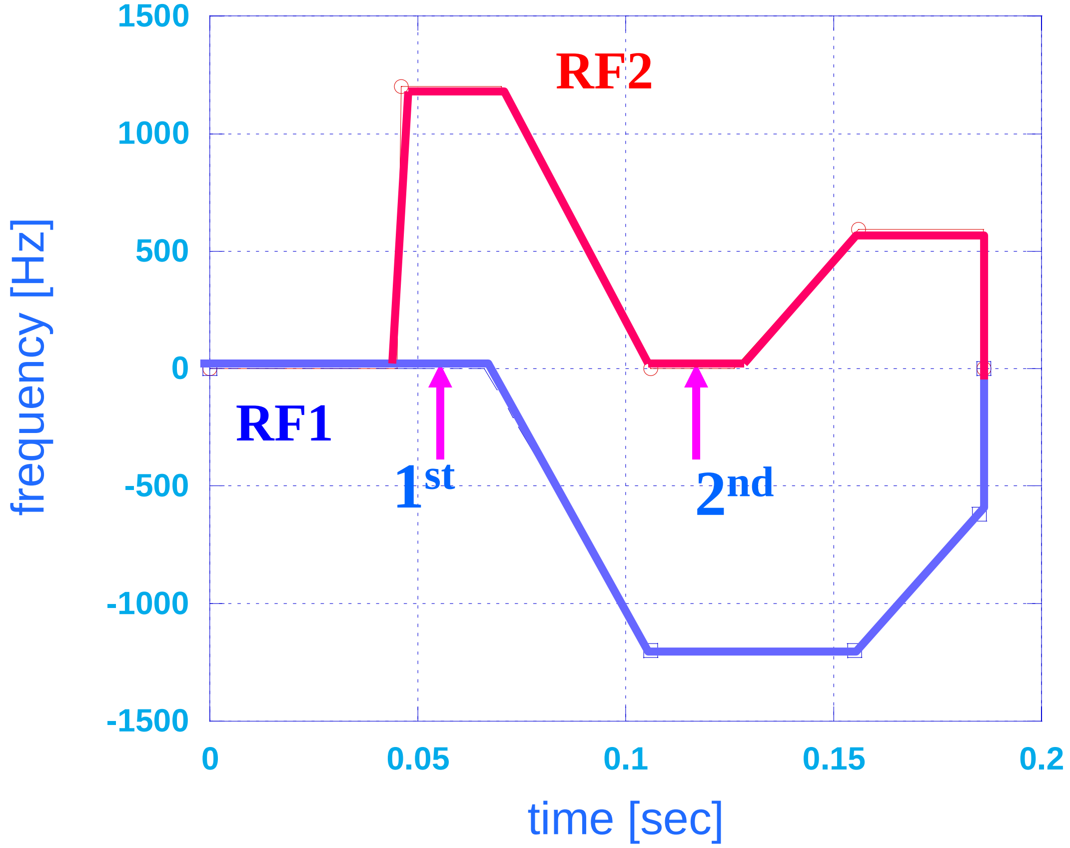
MI Collimation Review

06/30/06

Slip stacking procedure



Frequency curves

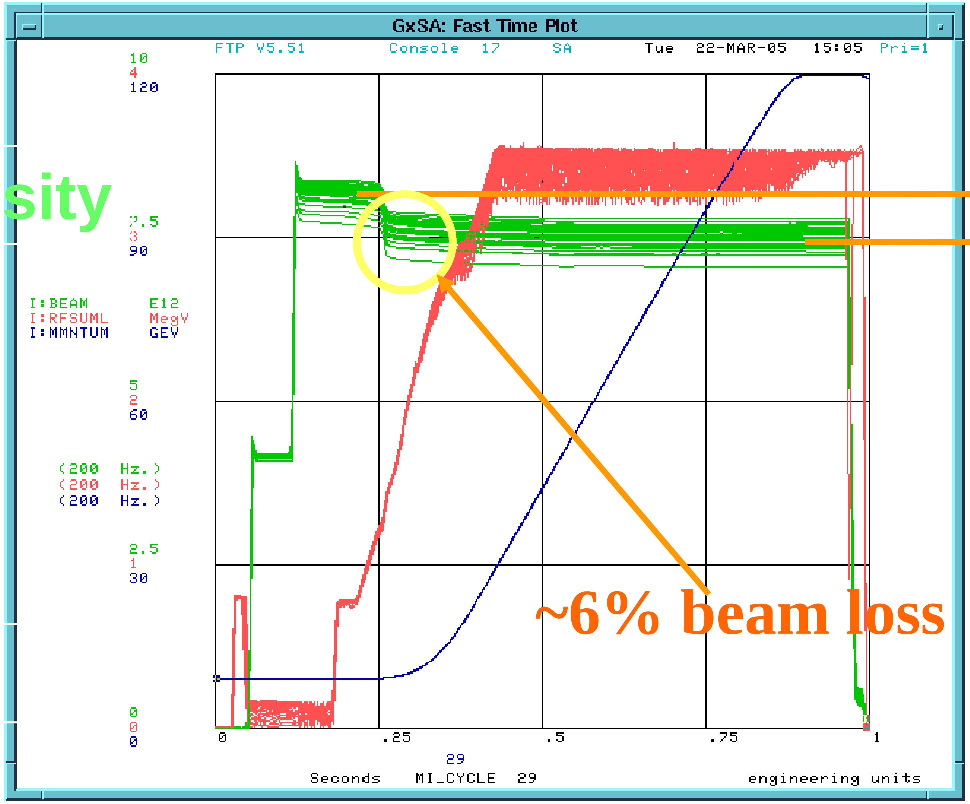


Total slipping time < 3 Booster cycles

Status in March 2005

- Intensity on target.: 7.0E12

Beam intensity



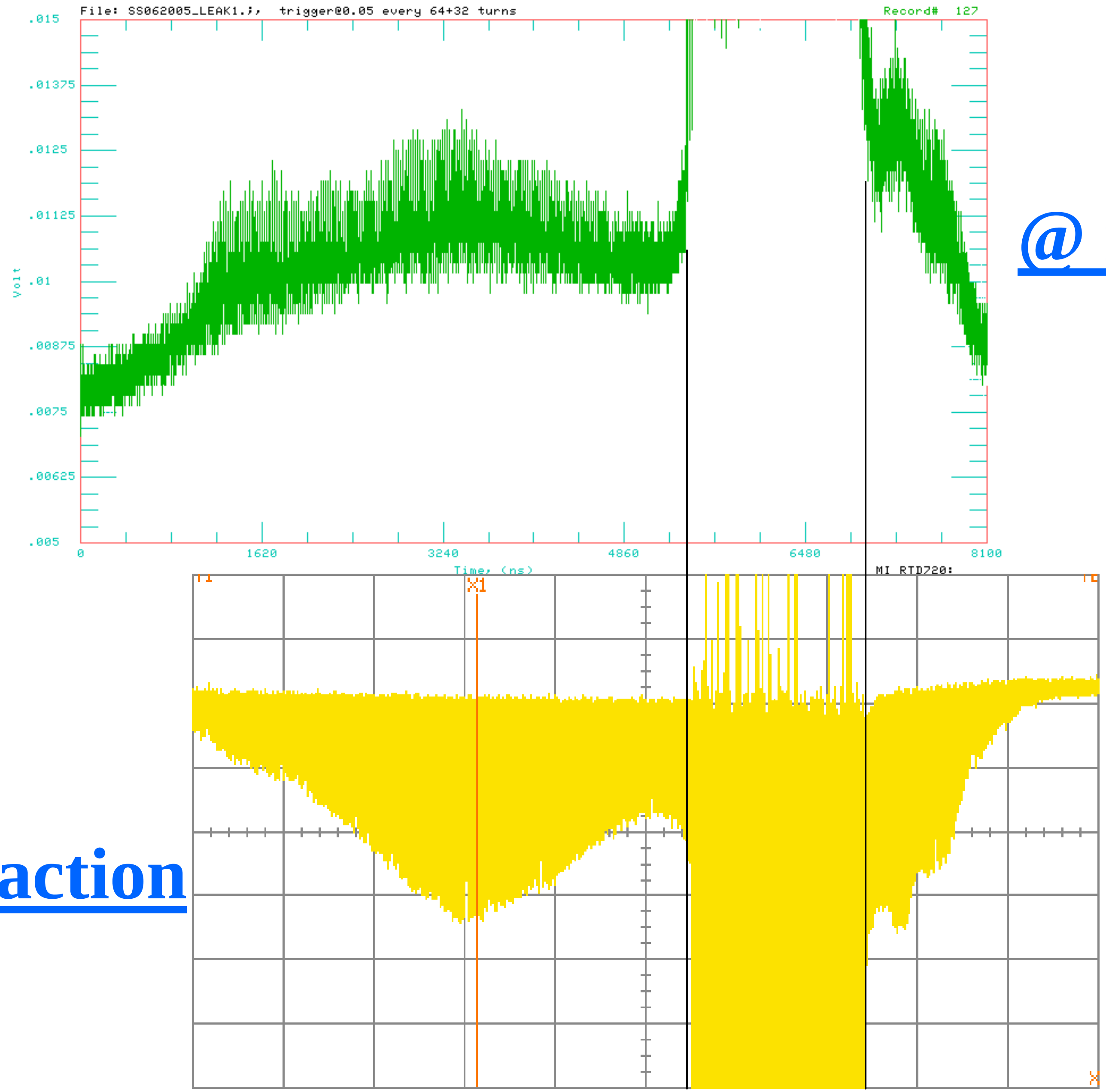
Momentum

8.0E12 @ inj.

7.5E12 @ ext.

7.0E12 @ Target

Leaks on WCM signals



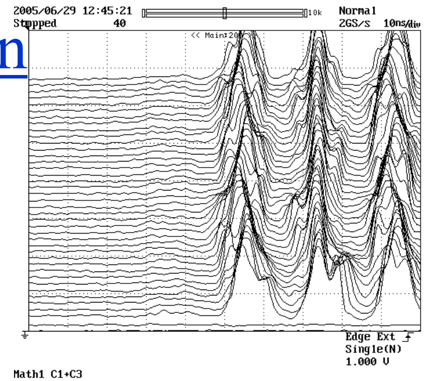
@ recapture

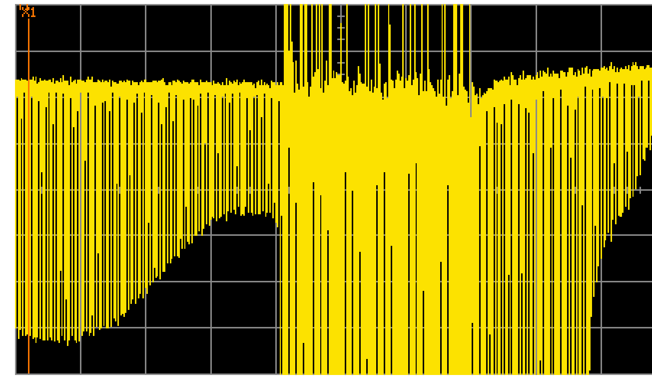
@ extraction

Mt. range plots @ Injection & WCM signals @ extraction

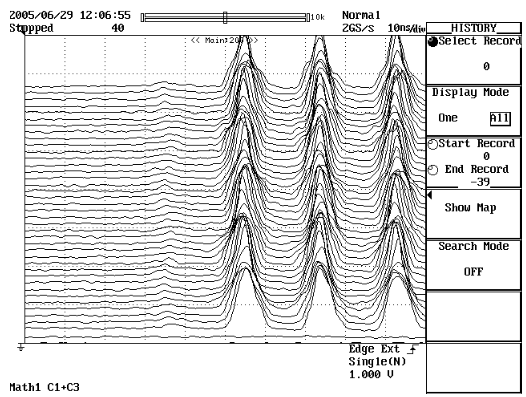
Intensity @injection

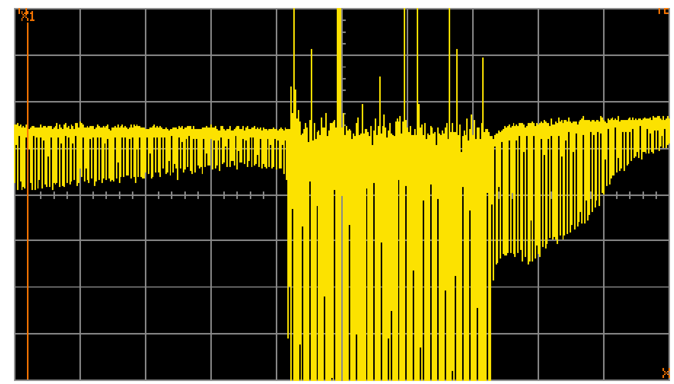
4.0E12



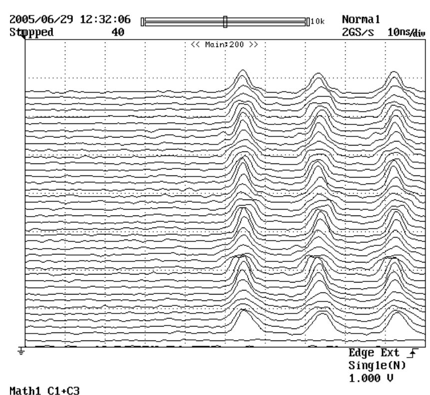


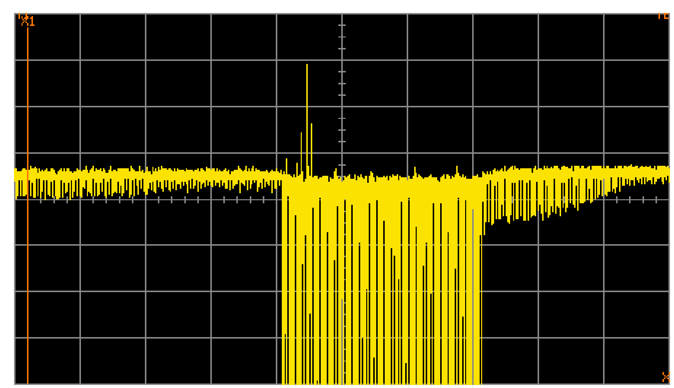
2.5E12





0.8E12





Improvements in Booster and MI

Booster: **Emittance 0.27eV-sec → 0.13 eV-sec**

Q-pole damper: Mode 0

D-pole damper: Mode 0,1,2,52

Tuned bunch rotation

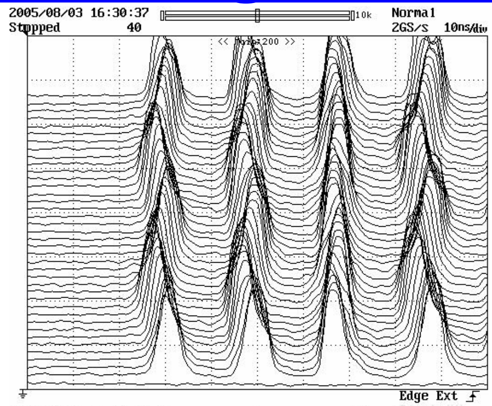
MI: **Optimized RF parameters**

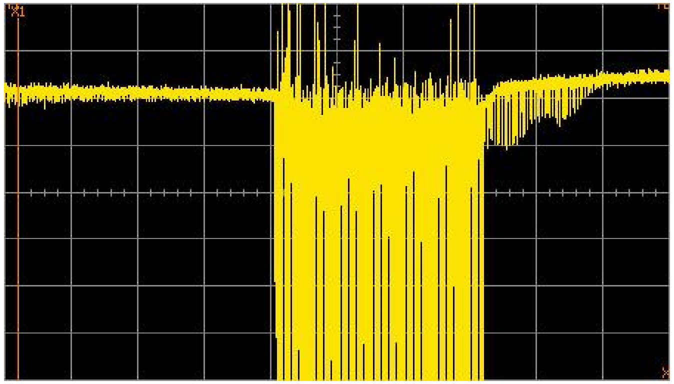
Frequency separation: 1200Hz → 1400Hz

RF voltage for slipping: 90 kV → 110 kV

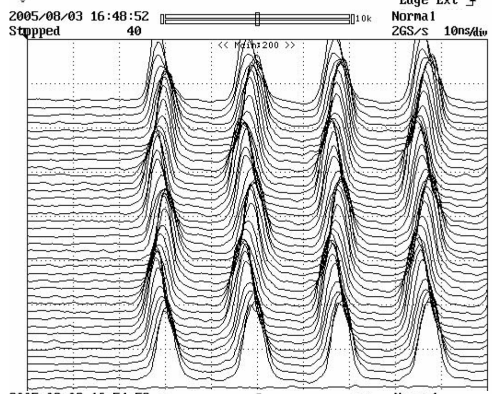
Mt. range plots @ Injection & WCM signals at extraction

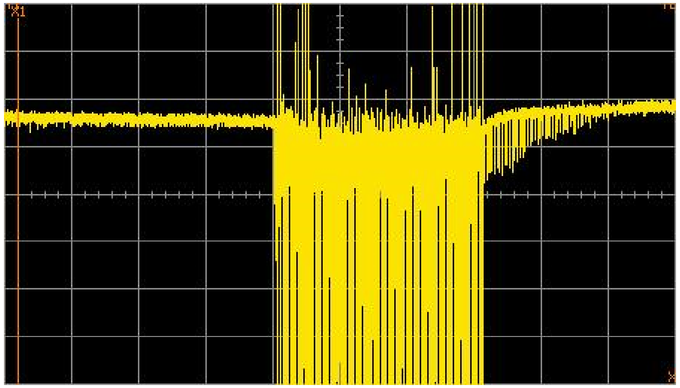
4.0E12



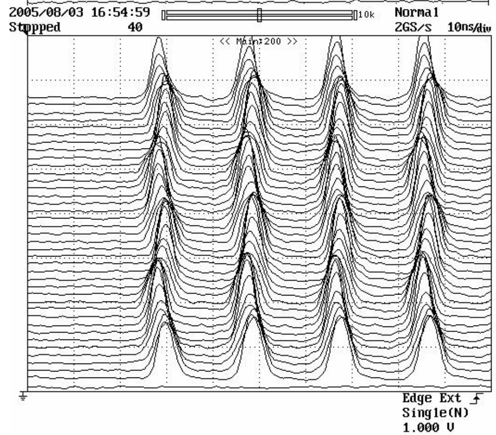


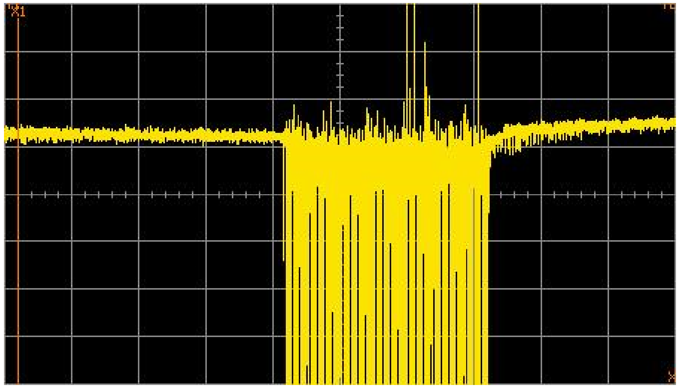
2.5E12





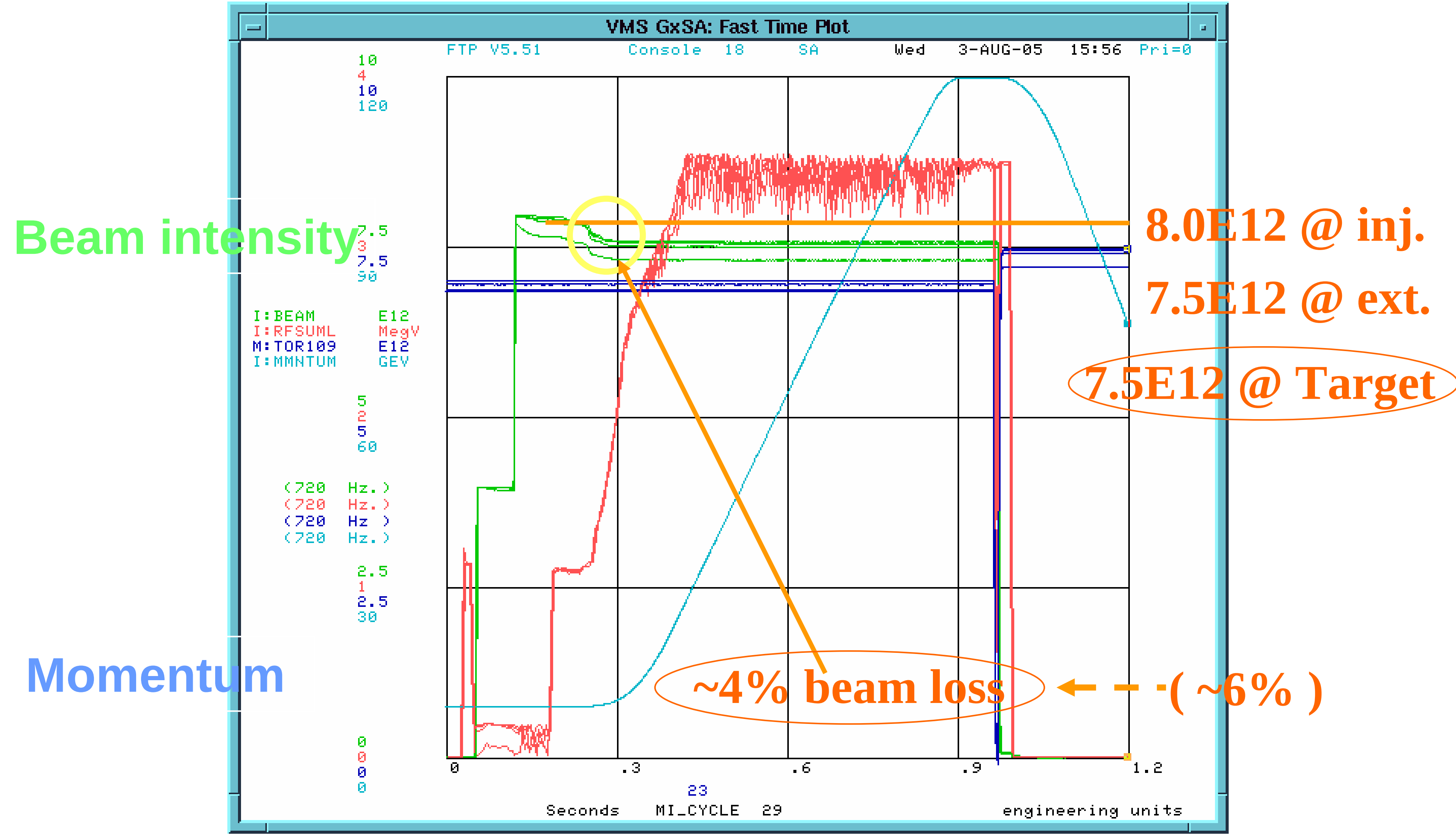
0.8E12



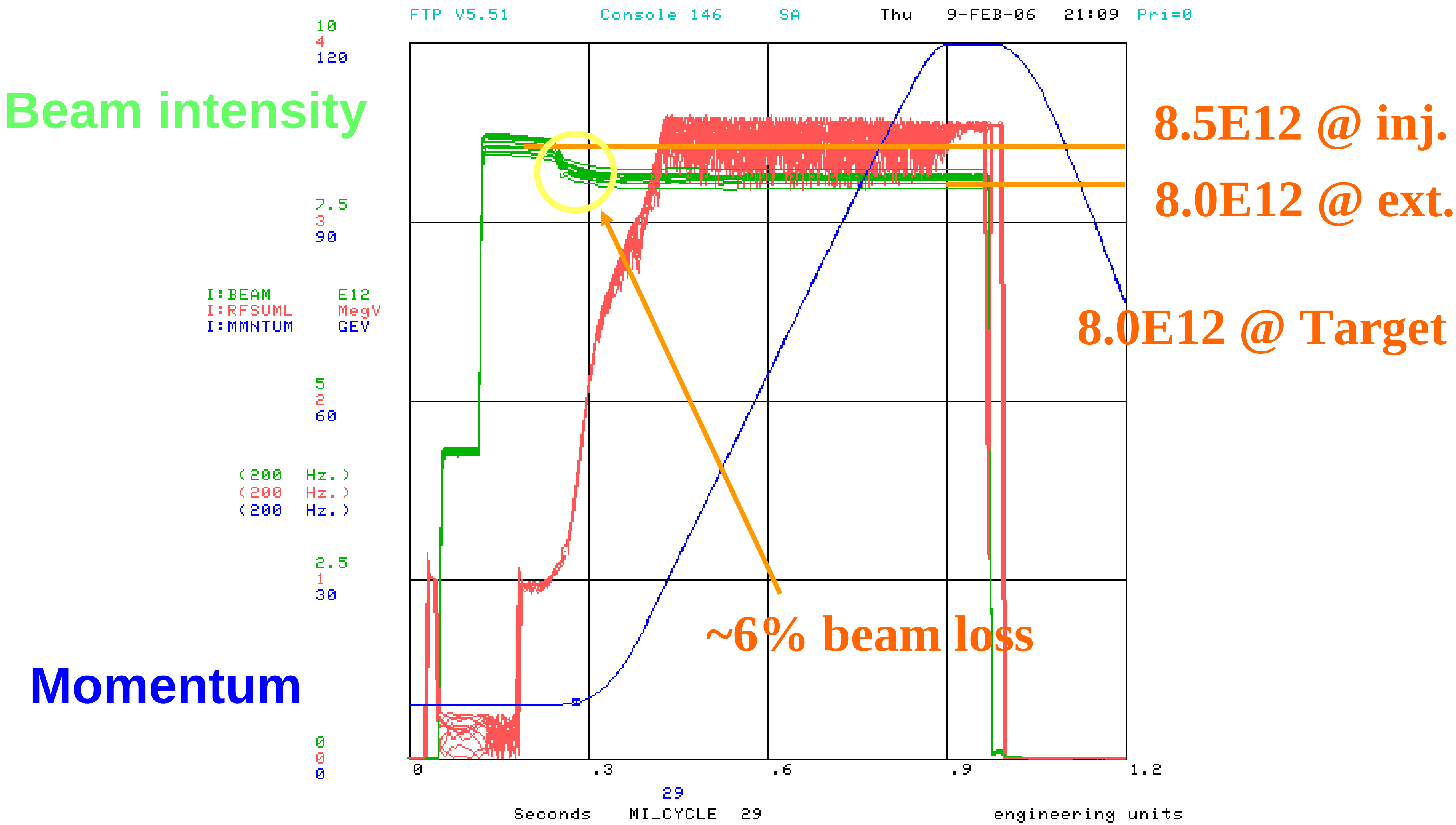


After beam studies

- Intensity on target.: 7.5E12

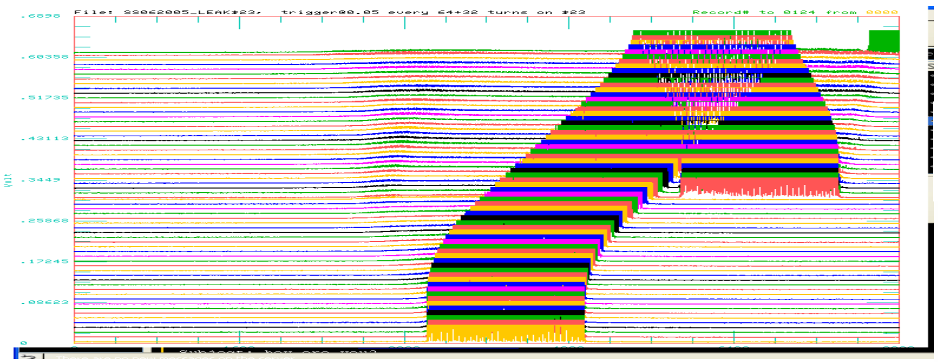


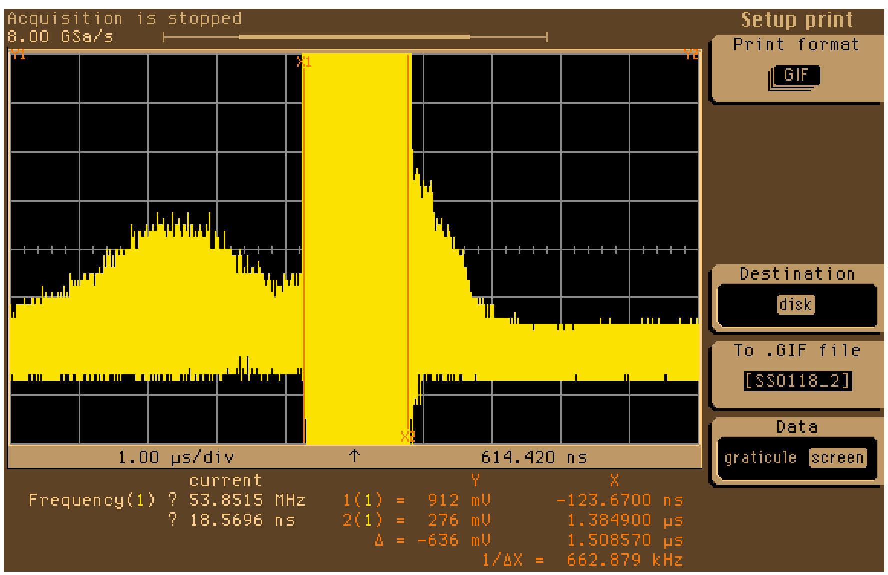
Status in February 2006

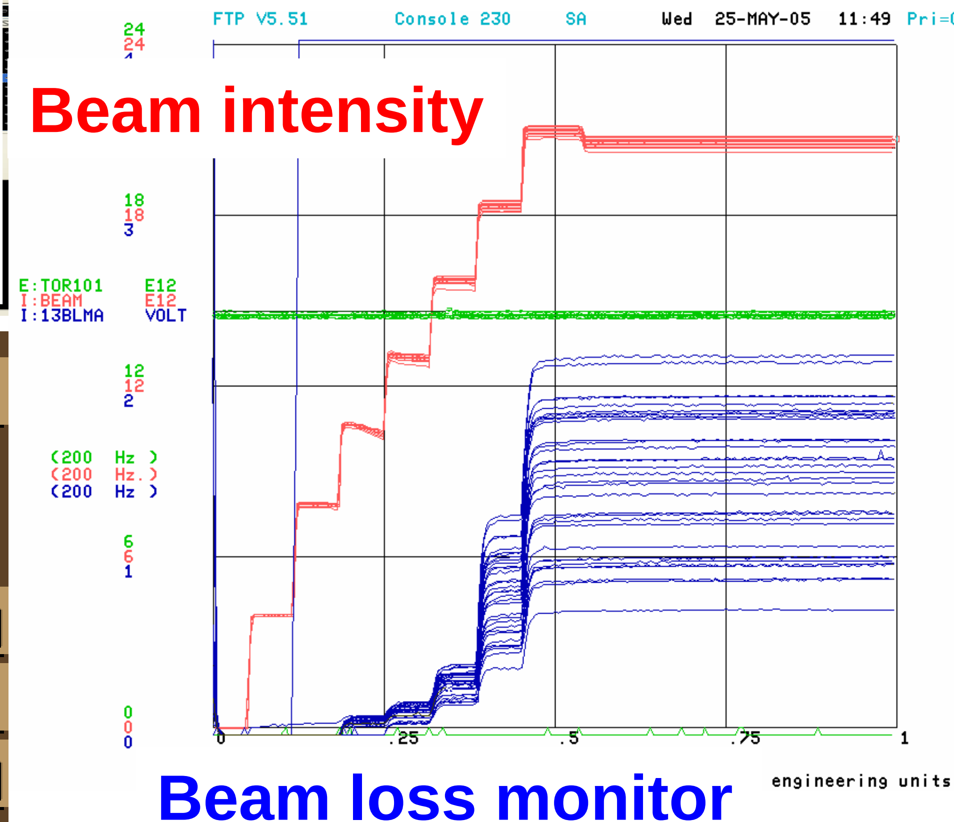


Beam loss on Injection kicker on current operation

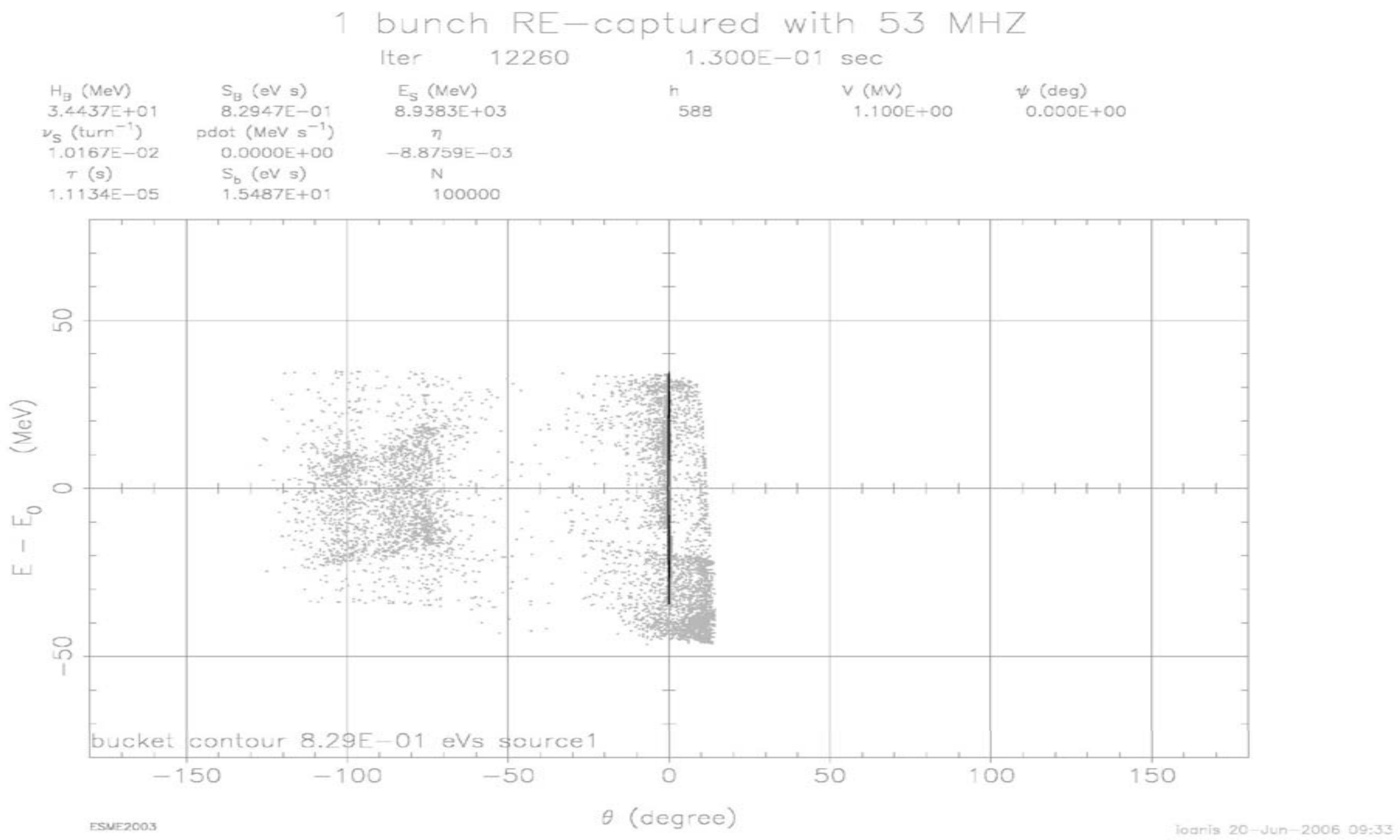
(mixed mode Slip stacking + Numi 5 batches)



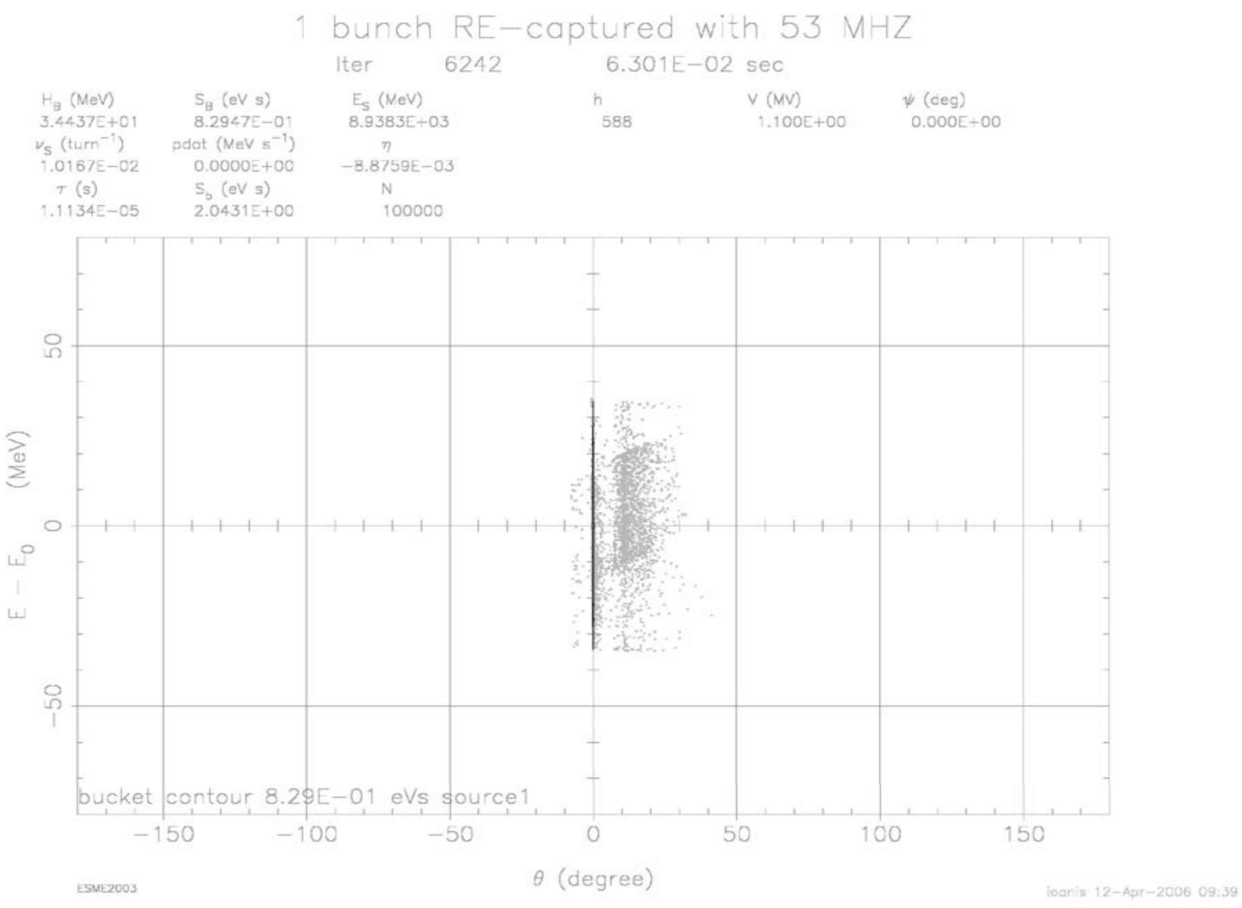




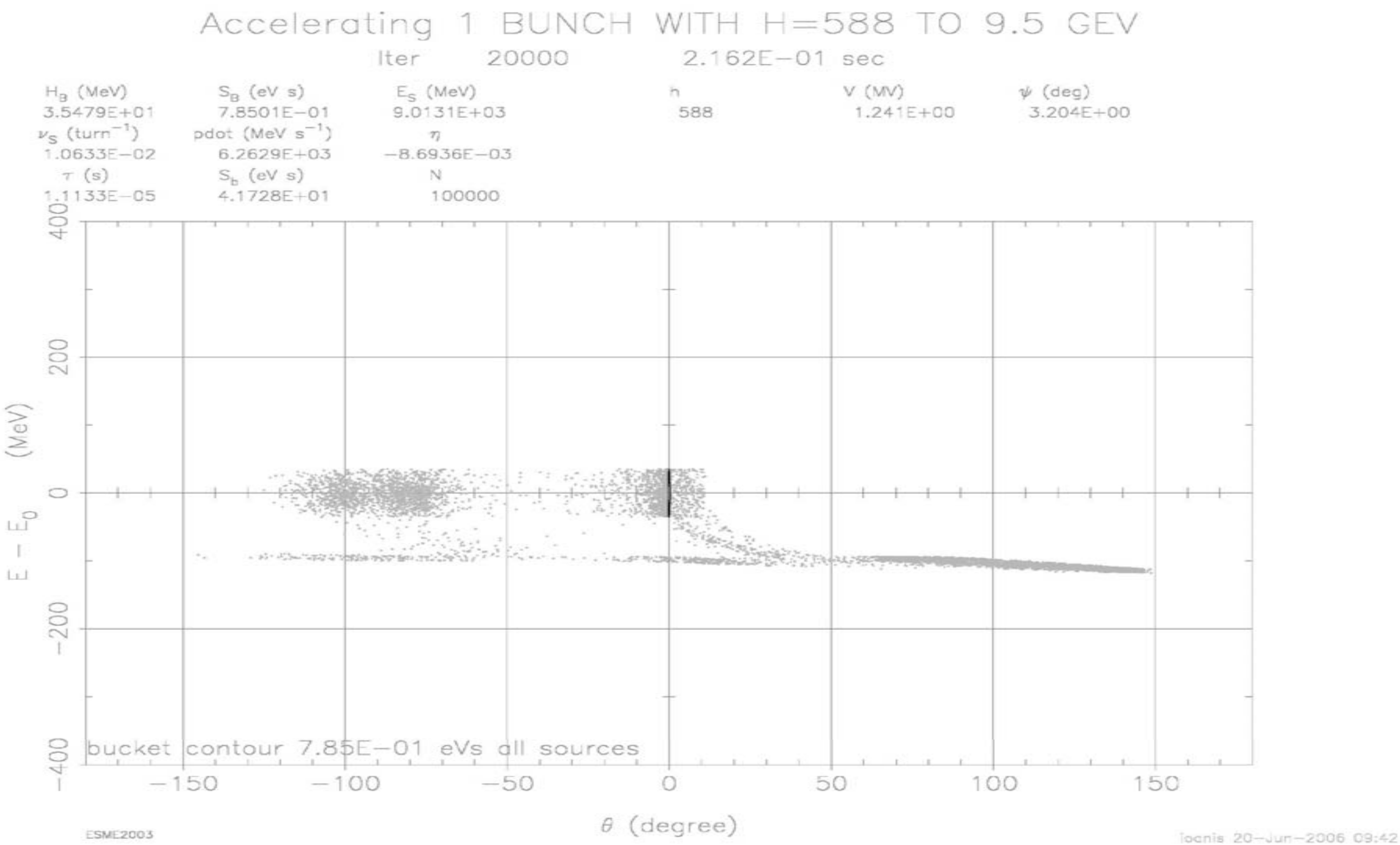
ESME Simulations of Regular Slip Stacking. First batch (bunch) of 0.18 eV-sec at the time of Recapture.



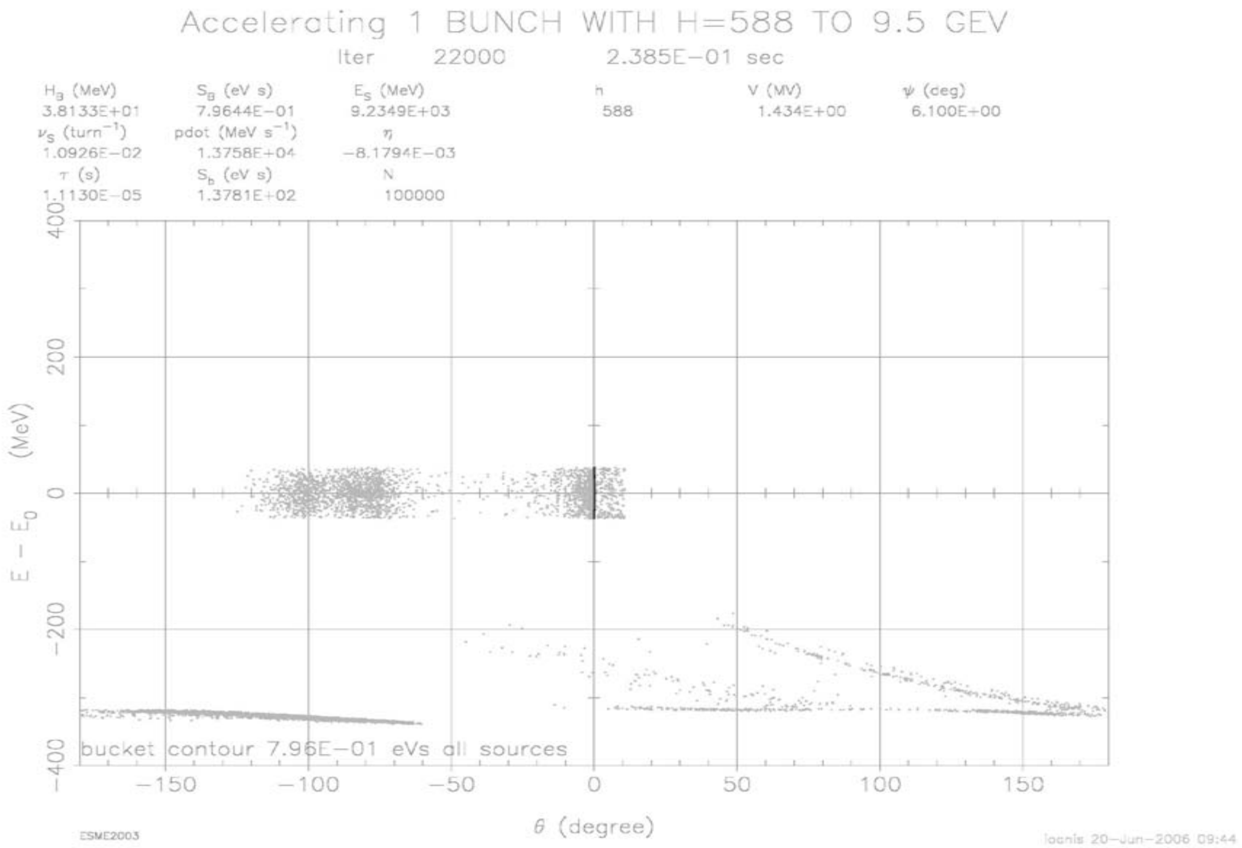
ESME Simulation of the Regular Slip Stacking. Second batch (bunch) of 0.18 eV-sec at the time of recapture.



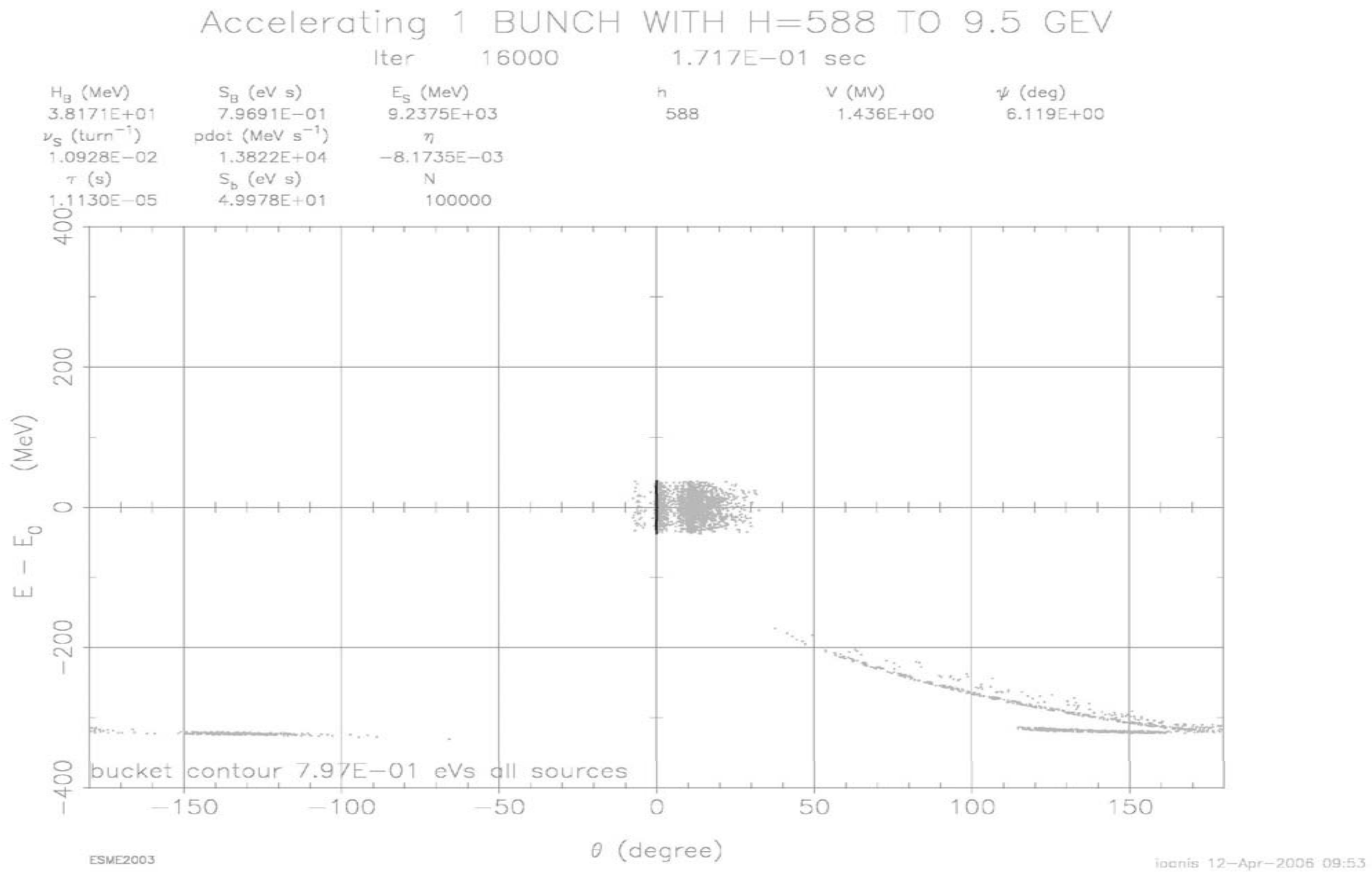
ESME Simulations of Regular Slip Stacking. Acceleration of the first Batch (bunch)



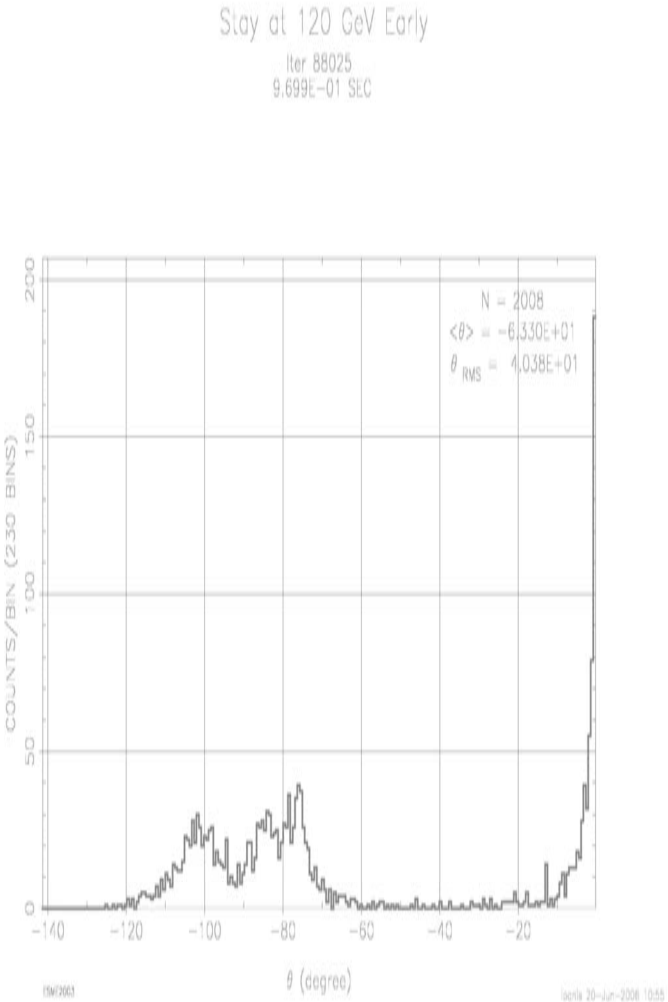
ESME Simulations of Regular Slip Stacking. Acceleration of first batch (bunch).

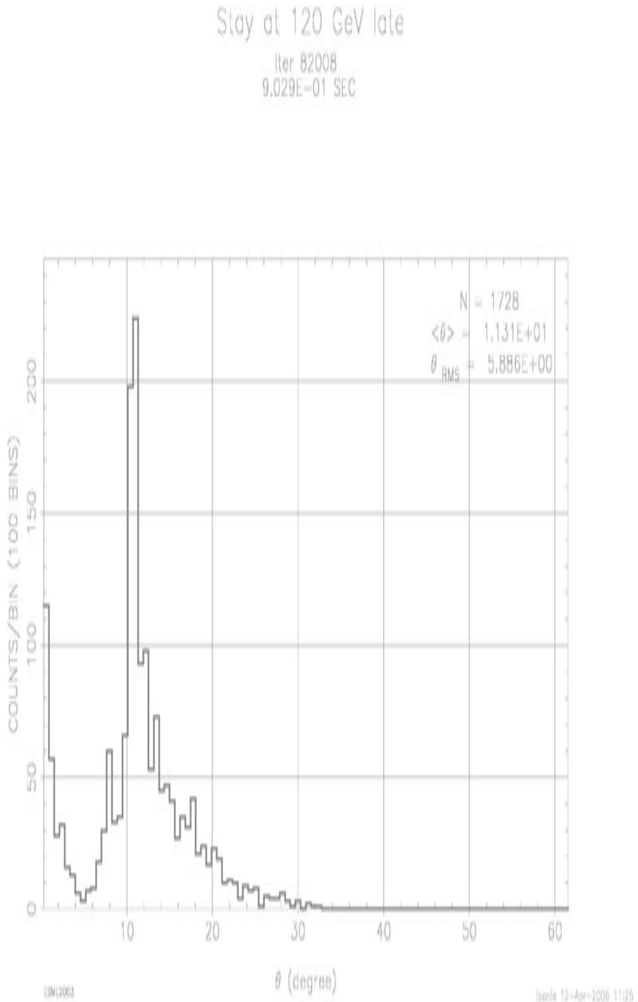


ESME Simulations of Regular Slip Stacking. Acceleration of the Second Batch (Bunch).

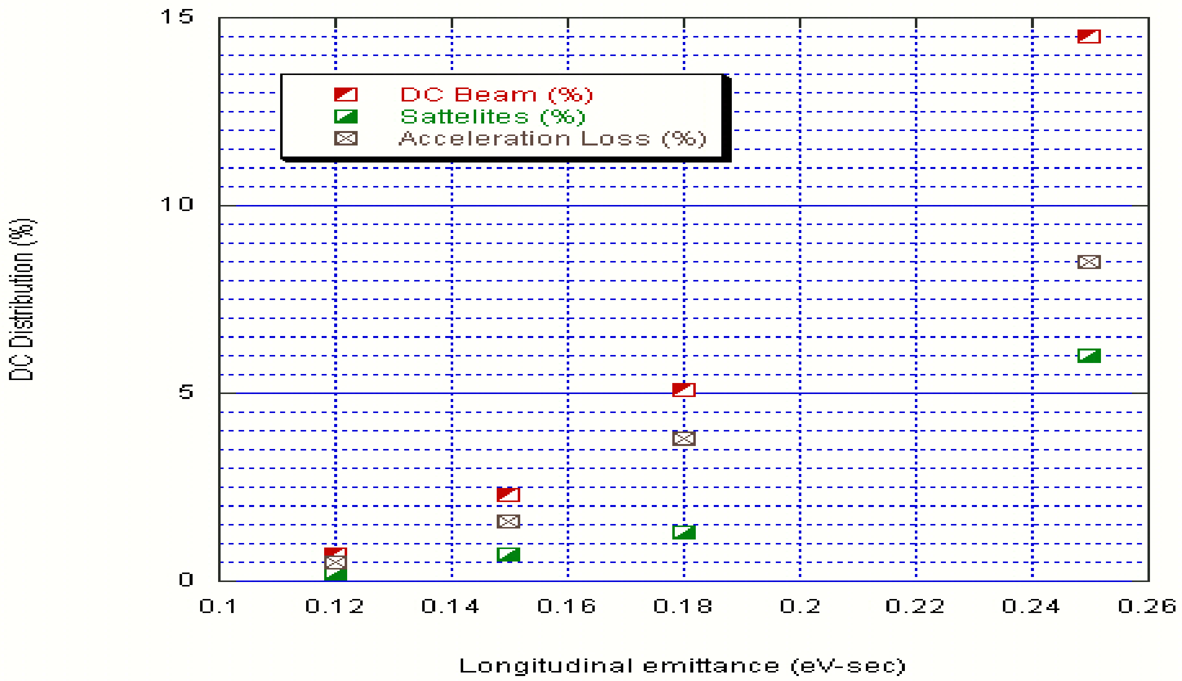


ESME Simulations of Regular Slip Stacking. Satellite bunch distribution at 120 GeV.

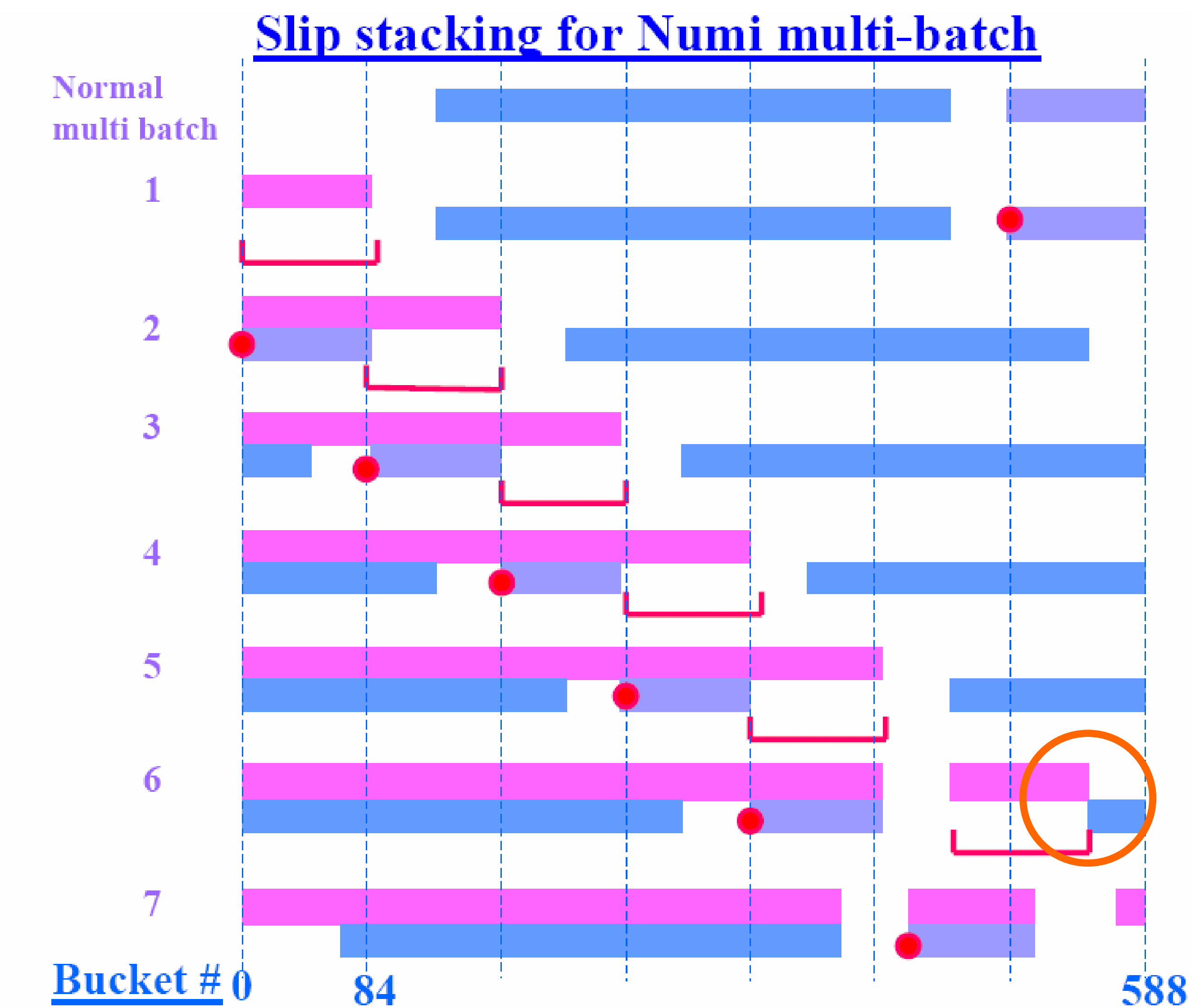




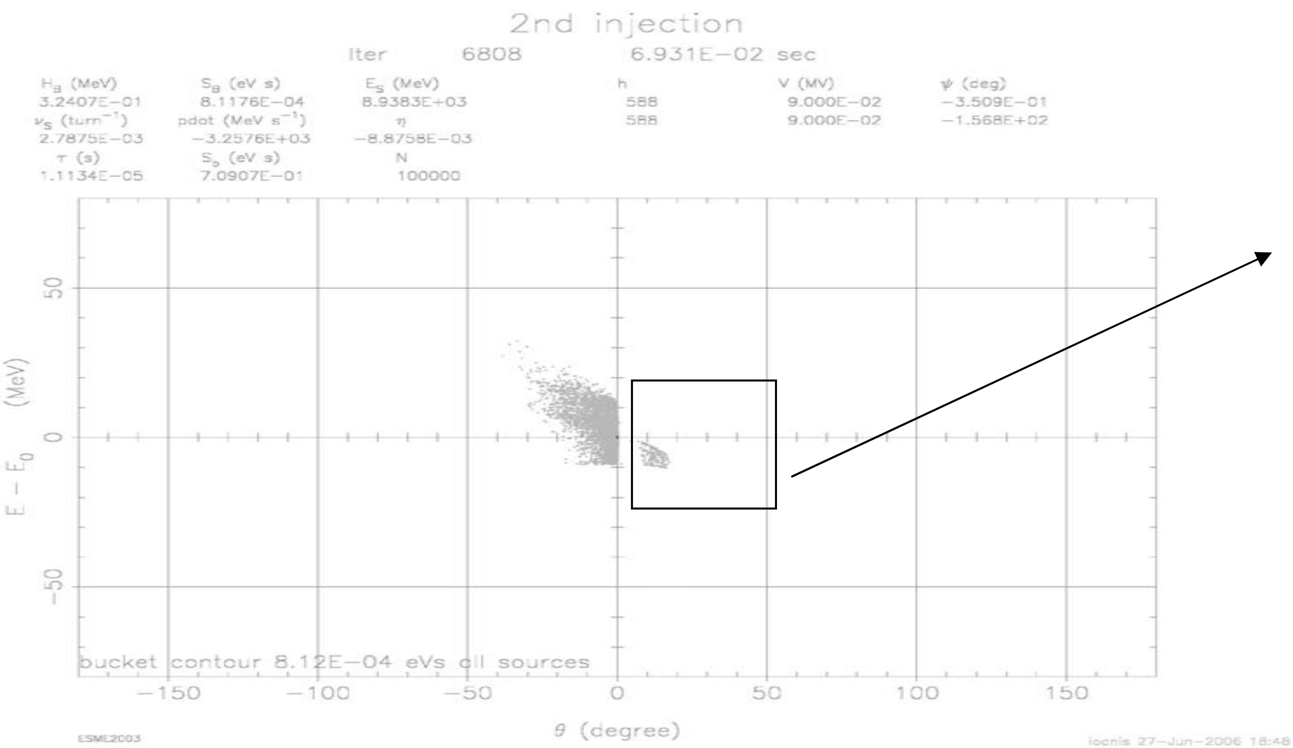
Loss from Regular Slip Stacking vs LE



Multi-batch Slip stacking for Numi operation

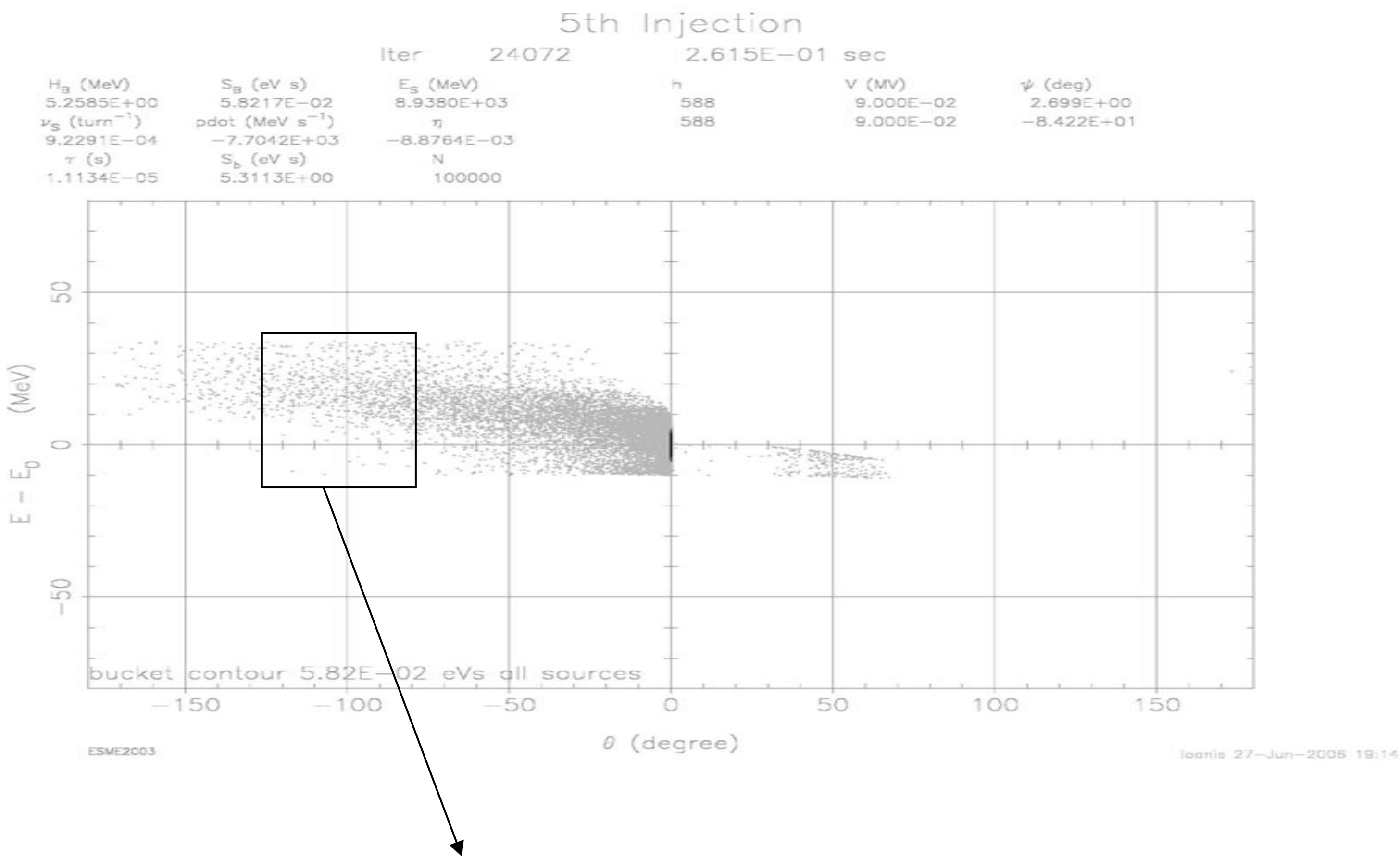


ESME simulations of Multi-batch slip stacking. First group of Injections. Distribution of particles from the first batch (bunch) at the time of the second injection.



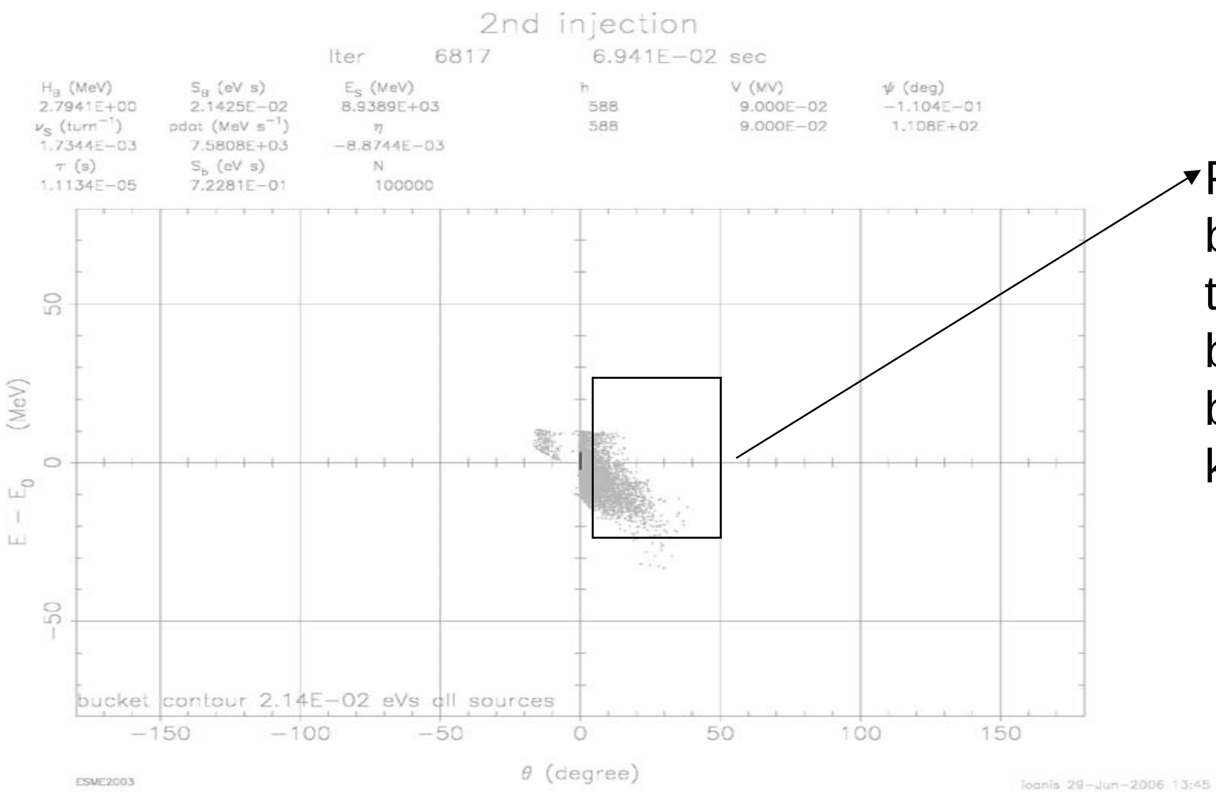
Position of the Second Batch. Very little DC beam is present in the kicker gap.

ESME simulations of Multi-batch slip stacking. First group of Injections. Distribution of particles from the first batch (bunch) at the time of the fifth injection.



Position of the fifth batch. In this case there is beam in the kicker gap only for the fifth injection.

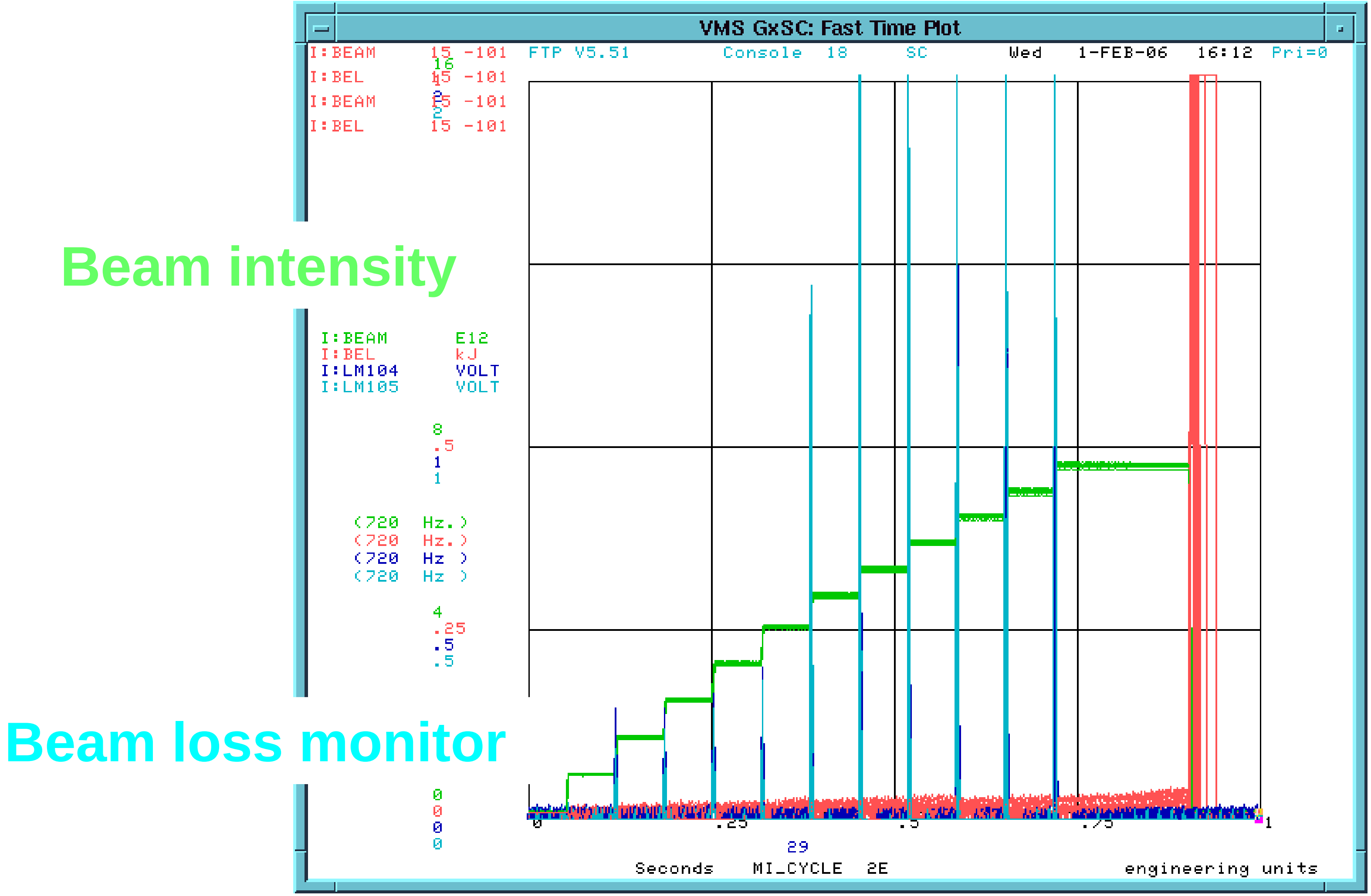
ESME Simulations of the multi-batch slip stacking. Second group of injections. Distributions of particles from the first batch (bunch) at the time of the second injection.



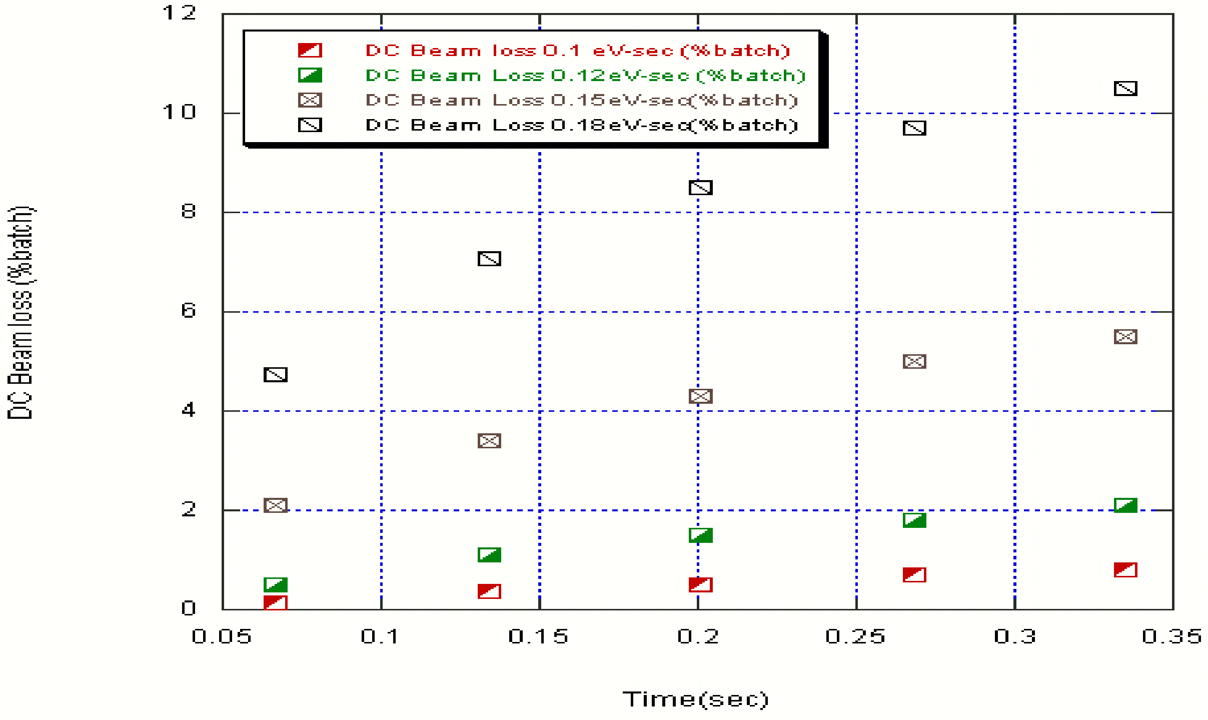
Position of the second batch. About 10% of the un-captured DC beam from the first batch will be in the kicker gap.

Multi-batch Slip stacking (beam study)

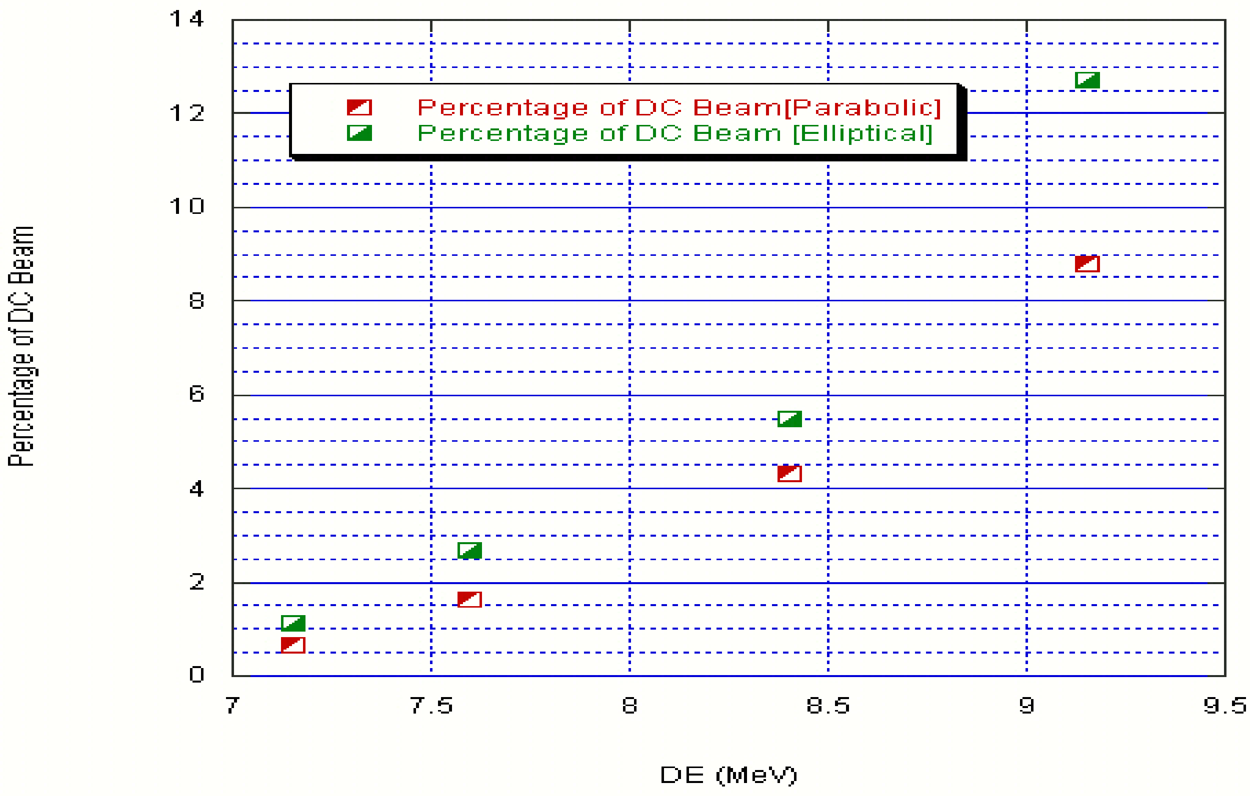
Beam loss on Injection kicker



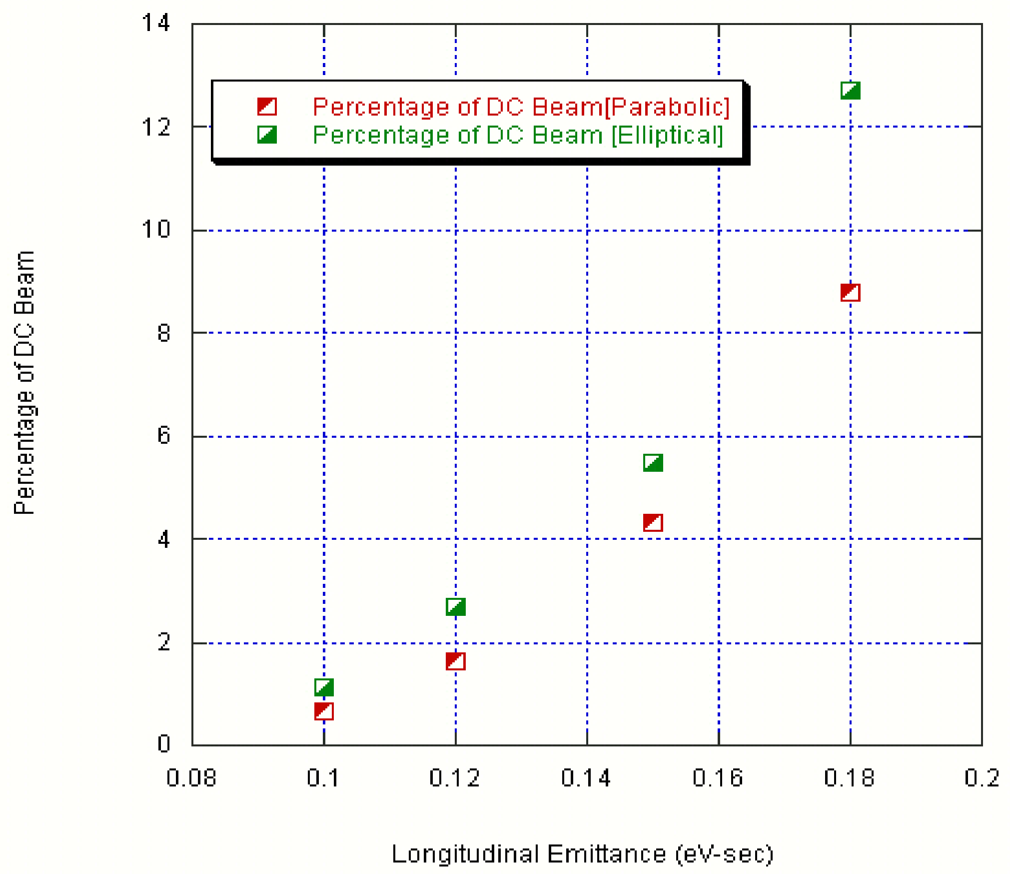
DC beam as a function of time from Injection for Different long. Emittances.



Total DC Beam generated during multi-batch slip stacking as a function of Dp (Half momentum height)



Total DC Beam generated during multi-batch slip stacking vs. Long. Emittance



Conclusions

- During Slip Stacking we generate un-captured beam (DC beam) a large fraction of which will be lost during acceleration.
- The fraction of DC beam depends greatly on the momentum spread of the injected beam.
- We cannot operate with multi-batch slip stacking without getting rid of the dc beam losses in a controlled way.